Quantification of Anthropogenic Emissions from an Urban Region: First Results of Time-Integrated Flask Samples from the Indianapolis Flux (INFLUX) Project

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INFLUX is a NIST-funded project to develop and assess methods of quantifying greenhouse gas emissions at the urban scale from top-down and bottom-up approaches, using Indianapolis as a test case. Indianapolis is an excellent test site, with relatively straight-forward meteorology; a contained, isolated, urban region; and relatively well-known emissions.

INFLUX incorporates atmospheric measurements from multiple platforms and methods, and bottom-up inventory estimates. This presentation focuses on flask measurements from the first two towers, installed in late 2010. These two towers are located upwind and downwind of Indianapolis in prevailing wind conditions (about 25% of the time). Flask samples are taken in mid-afternoon only on days when the appropriate wind conditions occur, determined each day using automatically generated HYbrid Single-Particle Lagrangian-Integrated Trajectory (HYSPLIT) back-trajectories. We will describe the newly-developed time-integrated flask sampling system used at the towers, which uses a 15 liter volume to integrate air from a one-hour period, before collecting a portion of the mixed air in glass flasks (figure 1).

Flasks are measured at NOAA ESRL and the Institute of Arctic and Alpine Research for ~40 species, including $\Delta^{14}CO_2$ (as a proxy for CO_2ff), CO_2, CO, CH_4, stable isotopes of CO_2 and a suite of halocarbons and hydrocarbons. Species associated with urban emissions are consistently enhanced in the downwind samples relative to the upwind site (figure 2). Enhancements vary through time and are inversely correlated with wind speed and boundary layer height.

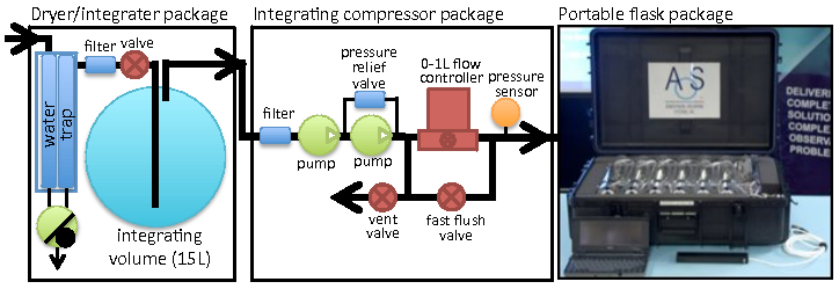

Figure 1. Time-integrated flask sampling system.

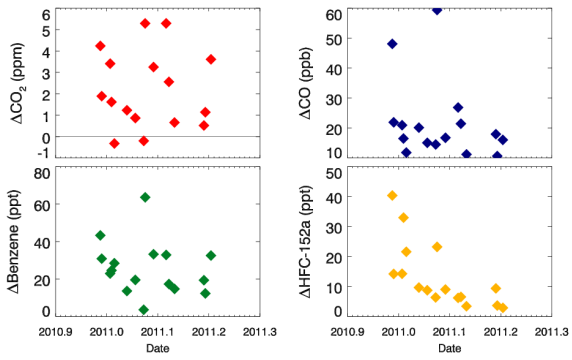

Figure 2. Enhancements in mole fraction of selected species at the downwind tower relative to the upwind tower.